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New York

1923

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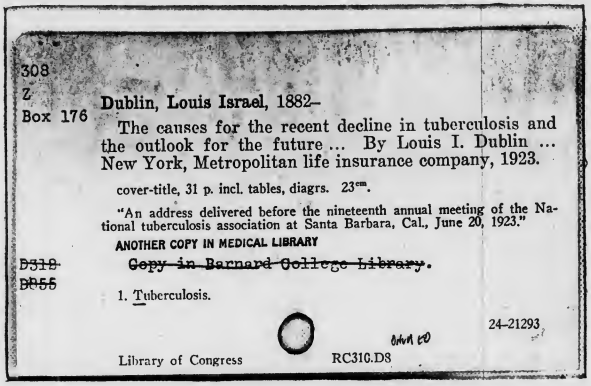
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The Causes for the Recent Decline in Tuberculosis and the Outlook for the Future

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An Address Delivered Before the Nineteenth Annual Meeting of the National Tuberculosis Association at Santa Barbara, Cal., June 20, 1923

By
LOUIS I. DUBLIN, PH. D., *Statistician*
METROPOLITAN LIFE INSURANCE COMPANY, NEW YORK

1923

THE CAUSES FOR THE RECENT DECLINE IN TUBERCULOSIS AND THE OUTLOOK FOR THE FUTURE

By Louis I. Dublin, Ph.D., Statistician
Metropolitan Life Insurance Company.

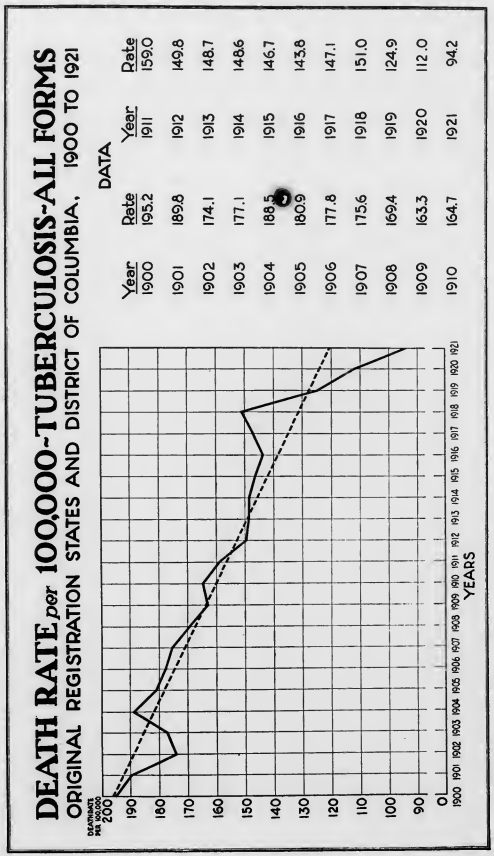
New York

I. THE STATEMENT OF THE PROBLEM

The decline in the tuberculosis death rate during the last twenty years is, in my judgment, the most outstanding fact in the tuberculosis problem. This decline has been large in amount and continuous in character. There has been no backsliding; there has never been any doubt as to the tendency of the tuberculosis death rate during the last twenty years. In 1900, (and that, by the way, was the first year for reliable statistics on tuberculosis for any large part of the United States) the death rate was 195.2 per hundred thousand of population. In 1910, the rate in the same geographical area, namely, the Original Registration States and the District of Columbia, had dropped to 164.7, or 15.6 per cent., in the ten year period. In 1920, the rate in the same states was 112.0. This is 42.6 per cent. less than the figure for 1900. In the second decade, that is, from 1910 to 1920, the rate fell 32 per cent., or a little better than twice as fast as in the first decade. In 1921, the rate went down to the low figure of 94.2 per 100,000, which is less than one-half the figure for 1900, only twenty-one years before. The general character of the decline is clear enough and is shown in Chart 1 and Table 1 on page 2. The straight line expresses the tendency during the period and is the most convenient expression, mathematically, of what has happened in the two decades.

Let me leave with you another picture, and that is of a group of some fifteen million people insured in the Industrial Department of the Metropolitan Life Insurance Company. Since 1911, accurate records of their mortality have been kept. Every death is recorded and the number of persons insured is also known. There is little room for error in the calculations. Now, in the year 1911, the rate of mortality for tuberculosis was 224.6 per 100,000 insured persons. These are working people, mind you,—men, women and children,—constituted, as to age and sex, about the same as is the general population. By 1921, the tuberculosis rate among these people had dropped to 117.4, and in 1922, it declined to 114.2. The decline between 1911 and 1922 was 49.2 per cent. The im-

CHART 1 AND TABLE 1



DATA

Year	Rate	Year	Rate
1900	195.2	1911	159.0
1901	189.8	1912	149.8
1902	174.1	1913	148.7
1903	177.1	1914	148.6
1904	188.5	1915	146.7
1905	180.9	1916	143.8
1906	177.8	1917	147.1
1907	175.6	1918	151.0
1908	169.4	1919	124.9
1909	163.3	1920	112.0
1910	164.7	1921	94.2

provement is continuing this year and, in the first six months, we have recorded a decline of 5.3 per cent. among white policyholders and of 2.4 per cent. among colored from the corresponding figures for 1922. Chart 2 and Table 2 on page 4 show what happened in this group of insured wage earners.

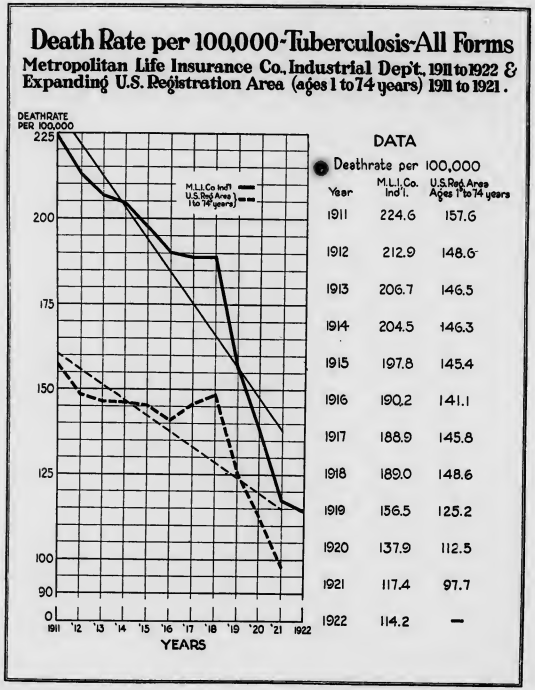
I have shown you that with reference to the general population, the death rate from all forms of tuberculosis has declined fifty per cent. in twenty years, and that in a large group of insured persons, the same amount of decline has occurred in a little over ten years. The improvement in the figures means that a hundred thousand fewer persons are dying each year in the United States from tuberculosis than would have died if the tuberculosis death rate of twenty years ago were still prevailing. That is an amazing fact, and, I believe, justifies my first remark that the decline in the death rate is the most outstanding item in the tuberculosis problem.

My purpose, however, is to discuss the causes underlying the decline. As you know, there is much difference of opinion as to what has caused the decline in tuberculosis mortality. The first step in a scientific discussion is to set for yourself a theory or a probable explanation on the basis of such evidence as is available and then to see how that theory squares with all the facts of the case. In connection with the decline of the tuberculosis death rate, there are two out-standing explanations. I shall consider these two opposing views and attempt to show you whether or not they square with the facts.

The first is espoused by most of the workers in the field of public health and ascribes the fall in the tuberculosis death rate during this period of twenty years and for a long period before to the great improvement in the general wellbeing of the population. The improvement is due, they say, primarily to activities within human control. Those who hold this view say that the great mass of the population is pretty generally exposed to infection, and that those who break down and become active cases of tuberculosis, and later die, are those who have not had the resistance to localize and control the foci of infection within them. With that thought in mind, the proponents of this view early developed a broad campaign of general education of the population. A knowledge of personal hygiene was widely disseminated in order that individuals might learn how to strengthen their resistance against the development of active symptoms of the disease. This was the keynote of the general campaign against tuberculosis as outlined by this Association when it was founded in 1904.

The campaign against tuberculosis was accordingly directed toward finding the large numbers of individuals who had broken down with the disease, to strengthen their resistance and to make them well again if possible and, second, to prevent their infecting others. That meant, of course, the establishment of such institutions as the tuberculosis clinic,

CHART 2 AND TABLE 2



the training of many physicians in the technique of diagnosis, the building of sanatoria for the care of early cases and of other institutions for the more advanced cases, and the segregation of those individuals, who having broken down, might become a source of danger to others. I need not enumerate all the activities and agencies which have grown out of this conception of the origin and control of tuberculosis. It is sufficient to say that all over the world a definite technique for the control of tuberculosis has been developed on the basis of this theory. This probably has received its best and most acceptable expression in the writings and practical works of Dr. Philip of Edinburgh.

The underlying principle of his campaign and of his followers has been that tuberculosis was subject to human control. The disease developed because of infection and the weakened defenses of the individual. This might be due either to undesirable conditions of the organic and physical environment or to weakened personal constitution, or to both. This school did not lose sight of the importance of the constitutional factor. It realized that there are differences in the capacity of individuals to resist the development of infection and breakdown. But, it saw that with respect to the constitutional factor, man could do very little except to make the most of what constitutional equipment he had. The emphasis of this group has, therefore, been placed where it could be effective, namely, in the constant improvement of the status of human beings. The campaign against tuberculosis has attempted to make the lot of men and women happier and easier, to improve their personal hygiene, to remove possibilities of gross infection and to give many individuals a fighting chance to throw off disease which they would not otherwise have in their usual methods of life. Acting on this theory, a flourishing and world-wide activity has developed and those associated with it have very naturally claimed that a measure of the decline which has appeared in this period may be credited to their and allied efforts.

The second explanation or theory minimizes the importance of the environmental factors in the control of tuberculosis. It places great emphasis on the fact that the decline in tuberculosis antedates by many years the development of the tuberculosis campaign as at present understood, going back, in fact, to the early decades of the nineteenth century. Those who support this second view emphasize the all importance of the genetic, that is, the constitutional factors. They grant the universality of infection, but they insist that those who break down are a special group whose constitutions, in advance, have doomed them to tuberculous disease. They insist, moreover, that the tendency to have tuberculosis is inherited like other physical characteristics, and that observation will discover a distinctively tuberculous stock or phthisical constitution, quite irrespective of the environment, mode of life, or any effort that man might make either to avoid infection or to build up individual resistance.

A corollary of this explanation has been that hardly any of the decline to which we have called attention could have resulted from the tuberculosis campaign. It is not in the nature of the disease, this group says, to be amenable to the kind of treatment that has been given to environmental factors. There is, as you know, a school of biological writers, who, for many years have labored to show that the tuberculosis campaign as

it has crystallized in official and voluntary agencies, was doomed to failure. In its extreme form as stated by Dr. Given and quoted by Professor Pearl of Johns Hopkins University, the view is expressed that "there is no evidence that anything that man has done has affected in either one way or the other the decline in the mortality of tuberculosis which has been continuous for nearly three-quarters of a century." In fact, it has been urged that such effort as has been made is likely to have done more harm than good by encouraging the reproduction of phthisical stocks and thus thwarting the influence of natural selection. The decline in tuberculosis, on this view, is ascribed to the influence of the disease itself as a selective agency in eliminating less fit stocks and thus preventing the reproduction of such individuals. Possibly, it is best to quote Professor Pearson's own statement.*

> "Has or has not the selection due to many years of heavy phthisis mortality left us with a more immune and resistant population? If it has—and that I believe will be found to be the ultimate explanation of the fall, especially the *retarded* fall in the phthisis death rate—then infection is not the only factor worth investigating. There is the question of hereditary immunity. It may be a bitter pill for mankind to swallow, when we suggest that natural selection may have done more for racial health in this matter than medical science, but it may have its compensations from the economic standpoint. Above all, it may suggest that Evolution helps man better than he at present knows how to help himself, and that possibly he would learn to help himself better if he studied her processes of racial selection a little more closely."

II. A STATEMENT OF THE FACTS

These then are the two views which, I hope, I have stated clearly and without bias. The first emphasizes the importance of the environmental factors in the causation of tuberculosis and credits the improvement in the death rate to those human activities which have centered around the amelioration of the environment of the great body of people. The second emphasizes the importance of stock and ascribes the decline to secular changes in the germ plasm of nations and of races which follow from the full interplay of natural forces rather than from the conscious interference of man with nature. After all, these are only attempts at an explanation. They have no assured validity unless they square with the mass of facts. I will, therefore, rehearse some of the commoner characteristics of the disease, tuberculosis, and shall try to see how often each of the two views appears to be consistent with or in opposition to the facts. The factual data are so numerous and often so clear-cut that we should have little or no difficulty in determining which of the hypotheses we have outlined has the better of the argument.

* "The Fight against Tuberculosis and the Death Rate from Phthisis."—pp. 34–35.

TABLE 3

Death rates per 100,000 Population in U. S. Registration States
Tuberculosis—all forms
1917

*Urban and Rural Areas Compared**

States	Urban	Rural
Total Reg. States of 1917	159.2	130.3
California	179.9	190.1
Colorado	250.3	129.9
Connecticut	171.0	155.7
Indiana	155.2	133.8
Kansas	82.2	49.6
Kentucky	227.1	191.1
White	168.9	164.7
Colored	526.5	462.4
Maine	144.5	105.5
Maryland	225.5	178.4
White	164.4	144.1
Colored	596.2	322.9
Massachusetts	141.5	152.4
Michigan	131.1	90.5
Minnesota	131.2	86.7
Missouri	166.8	134.7
Montana	149.3	105.3
New Hampshire	119.1	107.9
New Jersey	138.6	180.7
New York	168.3	131.4
North Carolina	271.2	128.1
White	196.5	88.0
Colored	402.1	218.0
Ohio	167.5	117.6
Pennsylvania	152.9	118.8
Rhode Island	173.6	113.3
South Carolina	249.3	134.6
White	139.2	63.3
Colored	384.7	195.3
Tennessee	234.2	190.8
White	148.6	157.1
Colored	413.5	347.2
Utah	52.0	38.6
Vermont	132.0	83.6
Virginia	194.4	105.2
White	128.4	106.3
Colored	328.3	302.3
Washington	72.4	90.0
Wisconsin	102.2	96.3

* The term "urban" indicates municipalities of 10,000 inhabitants or more in 1910, smaller places being included under the term "rural."

Geographical Variation in the Tuberculosis Death Rate.—The first fact is the great variation in the amount of fatal tuberculosis in various parts of the United States. Tuberculosis is preeminently an urban disease. It is, of course, present in rural sections of the country, but to a lesser degree. The latest figures that we have showing the contrast are for the Registration States in 1917. In that year, the rate in the cities was 159.2 and in the rural area 130.3 per 100,000. The Census Bureau has not published any figures distinguishing between rural and urban areas since then. We have also figures for each of the states of the country showing the distinction between rural and urban groups of the population. In almost every instance, the rate for the urban areas is materially higher than for the rural areas. Please remember, also, in this connection, that many of the sanatoria and hospitals for the tuberculous are located in rural areas, and that these civil divisions are usually charged with all the deaths that occur there, although many of the patients are city residents. If the necessary corrections were made for original residence, the difference between the two rates would become all the more marked in favor of the country. Table 3 on page 7 presents the data for the urban and rural parts of the Registration States in 1917.

Then, too, you are familiar with the fact that the death rate from tuberculosis is very much lower in some states than in others. The lowest rate in 1921 is found in Nebraska, namely, 37.1 per 100,000. Utah had a rate of 39.9; Kansas, a rate of 43.3. Beginning with these minimum rates, the figures increase gradually until we get to New York with a rate of 102.4, Rhode Island with a rate of 108.0 and Delaware with a rate of 140.6. There are even higher rates as, for example, for California and Colorado, but we realize that these high rates are due in large measure to the migration of tuberculous persons to those areas. It is, therefore, unfair to use the last figures in interstate comparisons. But, excluding these states, the figures, varying from 37 in Nebraska to 140 in Delaware, present a fair range of variation in the states of the country. (See Table 4, page 9).

Finally, we may note the diverse rates in the large cities of the country. There is first Akron with a rate of 46.9 in 1921; Salt Lake City, 61.7, and Grand Rapids, 63.7. Further down the list, we find such cities as New York with a rate of 104.3, Cambridge, 125.0 and Toledo, 125.3. At the end of the table, we find cities like Cincinnati, 152.7, and Denver and San Antonio, with rates above 200 per 100,000. But, the high rates in the last two cities reflect the concentration of migrant tuberculosis within their limits. (Table 5, page 11).

Here, then, are our first facts. Let us try to square them with the two explanations. The environmentalists, although I use that term advisedly, approach this phenomenon of extreme variation in the tuberculosis death rate without hesitation. They are familiar with it and have, in fact, based much of their assurance on it. Those who live in the country,—the rural population,—they say, might be expected to have a

TABLE 4

Death rates per 100,000 Population in U. S. Registration States and Area Tuberculosis—all forms.

1921

Area and States	Death rate	Area and States	Death rate
U. S. Reg. Area	99.4	North Carolina	104.8
		White	69.3
Orig. Reg. States of 1900	94.2	Colored	187.4
States ranked according to deathrate in 1921:		Rhode Island	108.0
		Mississippi	111.1
Nebraska	37.1	White	49.5
Utah	39.9	Colored	167.2
Kansas	43.3	South Carolina	111.2
Montana	61.8	White	52.4
Vermont	69.5	Colored	168.0
Michigan	72.5	Louisiana	122.4
Wisconsin	75.2	White	69.4
Oregon	76.0	Colored	207.2
Minnesota	77.0	District of Columbia	126.6
New Hampshire	78.9	White	75.2
Maine	82.1	Colored	278.2
Washington	82.7	Kentucky	131.2
Illinois	84.9	White	110.0
Ohio	89.1	Colored	333.1
Pennsylvania	92.3	Virginia	133.4
White	83.8	White	86.1
Colored	333.0	Colored	246.0
Indiana	92.8	Maryland	135.5
Missouri	93.0	White	102.1
New Jersey	93.6	Colored	301.8
Florida	95.7	Tennessee	139.9
White	62.4	White	106.6
Colored	162.5	Colored	282.0
Connecticut	95.9	Delaware	140.6
Massachusetts	98.5	California	151.1
New York	102.4	Colorado	184.6
White	97.7		
Colored	321.7		

lower rate. They are engaged in more healthful occupations; they live in less congested places; they live more normal, happier lives; they enjoy a larger and better supply of food and lead altogether a more wholesome existence. Those who live in cities, on the other hand, are in more congested quarters and, therefore, more subject to infection; they are often engaged in industries which are more distinctly hazardous to general health; they are on the whole poorer and less well supplied with

good food and fresh air. Life is harder and more hazardous in the cities and there are more chances for the natural resistance of the individual to break down.

They explain the differences in the rates in the various states and cities in much the same way. They stress the fact that often those places which have the lowest rates excel in their efforts to make life better. Some are the states and cities where the people are most intelligent and prosperous, least crowded and driven in their efforts to make a living. Often they are the centers which have deliberately made the greatest effort to meet their tuberculosis situation by providing adequate facilities for the care of the sick and for the education and protection of the well. The geographical differences in the death rates reflect for the most part, the environmentalists say, the differences in the arrangements which the communities have made to make life in them happier and better.

The geneticists or the constitutionalists, on the other hand, have not made much of the facts of geographic variation, and it is difficult to summarize the views that they hold in explanation of these facts. Obviously, it would be necessary for them to assume that the differences in the death rates represents differences in the innate stocks with various degrees of immunity or resistance to tuberculosis in the several parts of the country. They are compelled to posit a hierarchy of constitutional vigors corresponding to the low rates and the high rates. They must assume that the population in the rural areas is constitutionally better selected than that in the cities; that the population living in Nebraska, for example, is a fitter population than that living in Delaware or in New York; that the people living in Akron are innately more vigorous than those living in Providence. Without any desire to prejudge the case from this single line of evidence, it must be clear, I think, that on the score of variation of the death rate, the environmentalists have very much the better of the argument on the first count. Their assumptions are consistent with everyday observations of the differences in the modes of life and in the general level of wellbeing in the various parts of the country. Their explanation does not add difficulties which in their turn need expounding. But, the explanation of the second group has simply substituted one difficulty for another. There is no warrant in fact for any such degree of difference in our races and populations as their theory would demand. The people of the various states and cities are, with a few outstanding exceptions, altogether too much alike in their inherited qualities and their race histories to explain the enormous differences we have described.

Sex and Age Variations.—But, of course, geographical variation is only one and the first test. Another fact about the tuberculosis death rate which is almost universal, is the marked difference in the death rate in the two sexes. Tuberculosis mortality is much higher among males than

TABLE 5

Death rates per 100,000 Population. U. S. Registration Cities in 1921

Tuberculosis—all forms.

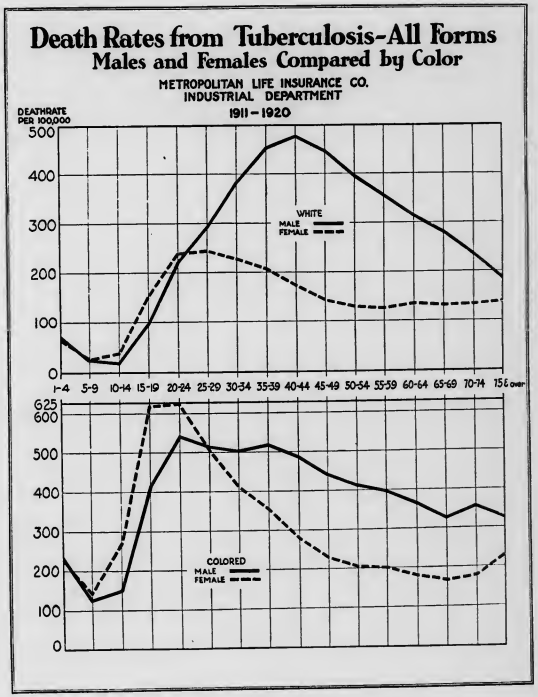
City	Deathrate	City	Deathrate
Akron	46.9	Wilmington (Del.)	106.7
Salt Lake City	61.7	Buffalo	110.7
Grand Rapids	63.7	Houston	114.4
Portland (Oregon)	64.2	White	93.3
Spokane	64.2	Colored	180.5
Rochester	67.8	Philadelphia	115.7
Syracuse	69.9	Boston	116.4
Milwaukee	70.0	Albany	117.4
Seattle	70.7	Atlanta	119.0
Reading	72.4	White	65.0
Oakland	73.3	Colored	239.0
Hartford	73.9	Kansas City (Kan.)	119.4
Springfield (Mass.)	76.5	White	76.7
Scranton	77.0	Colored	367.3
Omaha	77.1	New Bedford	124.0
Youngstown	80.1	San Francisco	124.5
New Haven	80.9	Indianapolis	124.7
Camden	81.1	White	101.1
Newark	81.1	Colored	310.0
Lowell	82.7	Cambridge	125.0
Minneapolis	84.7	Toledo	125.3
Chicago	85.0	Washington, D. C.	126.6
Dallas	86.5	White	75.2
White	54.8	Colored	278.2
Colored	270.4	Louisville	131.7
Jersey City	86.9	White	98.9
St. Louis	87.4	Colored	292.7
Dayton	89.8	Baltimore	139.5
Detroit	89.9	White	96.3
Trenton	90.5	Colored	388.1
Columbus	93.2	Birmingham	145.1
Fall River	96.9	White	52.2
Cleveland	97.9	Colored	288.6
Providence	98.0	Richmond	145.2
St. Paul	98.8	White	91.5
Bridgeport	99.0	Colored	264.9
Kansas City (Mo.)	99.7	Cincinnati	152.7
Paterson	101.9	Nashville	159.0
Pittsburgh	102.5	White	95.6
Yonkers	102.6	Colored	309.0
Worcester	102.7	Memphis	168.9
New York	104.3	White	80.8
Queens	77.5	Colored	317.8
Bronx	86.6	Los Angeles	173.4
Brooklyn	88.3	New Orleans	189.8
Manhattan	128.0	White	136.2
Richmond	154.2	Colored	341.4
Norfolk	105.6	Denver	219.2
White	51.5	San Antonio	251.5
Colored	194.8		

among females. Among the policyholders of the Metropolitan, (and similar conditions are found in the general population of the United States,) the death rate among white males during the period 1911–1920 was 36 per cent. higher than among white females. That is for all ages combined. Among the colored, the excess of the male over female mortality in the same period was 8 per cent. But, let us analyze these figures a little with reference to age. In Chart 3, page 13, the solid line shows the death rate from tuberculosis among males in the various age periods of life beginning with early childhood, increasing by five-year periods to old age. The broken line illustrates the facts for females. The aggregate, that is, taking the whole of life together, shows, as I have said, an excess of tuberculosis deaths among males. But, if we keep in mind the age element, the picture is somewhat different. In the first two age periods of life, up to the age of ten, the rates are so nearly the same that there is no point in making a distinction between the sexes. Beginning with age ten, the rate for females is higher than for males, and that continues for the next fifteen years of life up to age twenty-five for both the white and the colored groups. The excess of female over male mortality is, moreover, considerable. Beyond age thirty the rate for females drops rapidly and continues throughout the rest of life below that of males. The white male rate reaches its maximum at about age forty-two years and is then 477.2 per 100,000: the white female rate is highest at about twenty-seven, when it is 240.2 per 100,000. The curves for the two sexes are clearly very different. The excess rate of males is limited to the ages beyond thirty, while the females show an excess at the younger ages.

How do the two explanations square with this fact? The environmentalists would say that the boys and girls in our country are pretty much the same as to exposure and as to resistance. The higher rate for females at the ages of adolescence and early adult life they would explain on the assumption that at this period, developmental changes in the organism involve greater hazards than among males. The intense internal changes that accompany puberty and the mechanism of development to maturity in the female are sufficient, they say, to explain their lower resistance. The hazard of childbearing must also be considered. Pregnancy is often fatal among those who have incipient tuberculosis, and many breakdowns are traceable to the first childbirth. Moreover, in the last twenty years, a large and ever increasing number of young women and girls have gone into gainful occupations, remaining at work for greater or lesser periods and sharing with men the hazards of work, though possibly less well equipped for such strains.

In any case, the change in the sex-ratio of tuberculosis mortality comes at about the twenty-fifth year of life, and thereafter females enjoy decided advantages. Fewer of them are engaged in industry with the hardships of factory routine; they lead a more regular and sheltered

CHART 3



life; they indulge in fewer excesses, have better habits, and take better care of themselves. For these reasons, those who hold the first view would expect to find the facts with reference to the death rate in the two sexes very much as they actually are.

On the other hand, those who sponsor the theory of the constitutional factor in tuberculosis causation must explain the changing relationships of the death rates in the two sexes with advancing age. They must assume a difference by inheritance, or by selection, in favor of males at the younger ages and in favor of females at the older ages. There is no evidence for such differential hereditary endowment among brothers and sisters. I should say, however, that they have at no time, to my knowledge, addressed themselves to this problem or attempted to explain the phenomenon.

Racial Variability in the Tuberculosis Death Rate.—The third outstanding fact in a description of tuberculosis is the marked difference in the rate of mortality which prevails in the various nativity groups composing the population of the country. In a previous study, I have shown how different is the mortality from this disease in the six or seven principal stocks that constitute the population of the States of New York and Pennsylvania.* The figures are so clear-cut and so much the same in the two states studied that I would expect to find a similar situation to exist generally throughout the country. Table 6, page 15 shows the facts with reference to the mortality from tuberculosis for males and for females respectively.

In general, we found that the death rate was lowest among those born in Russia, who, in these two states are for the most part Jews. This interesting fact has been observed again and again not only in the United States but in other parts of the world where the mortality of Jews has been carefully studied in comparison with that of their neighbors. Tuberculosis does not appear to be as fatal among them as among other races. The disease when it appears is more often of long duration. The rates are also very low among the Italians. In fact, at some age periods, the rates were actually lower among those born in Italy than among those of Russian birth. The Austro-Hungarians, who in these two states are also often of Jewish extraction, show very low rates. These three nativity groups at many of the age periods show lower tuberculosis rates than those for the native whites. The native whites, on the whole, present an intermediate position between these three nativity groups and those born in Germany, Great Britain and Ireland. The highest rates are found among both males and females born in Ireland. This is more especially true in New York than in Pennsylvania, but in both states, the conditions in this race are notoriously bad. In

*The Mortality of Race Stocks in Pennsylvania and New York—by Louis I. Dublin and Gladden W. Baker. Reprinted from the Quarterly Publication of the American Statistical Association, March, 1920.

TABLE 6

Comparative mortality from pulmonary tuberculosis of different race stocks in New York and Pennsylvania, 1910

SEX AND AGE PERIOD	DEATH RATE PER 100,000 LIVING AT SAME AGES OF PERSONS BORN IN																			
	Austria-Hungary		Russia		Italy		Germany		England, Scotland and Wales		Ireland		United States (whites only)	
	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York
Males:														
All ages	118.0	166.0	107.4	114.7	81.5	112.1	194.9	267.4	150.2	215.2	342.8	589.3	105.1	170.9
Under 10	13.8	16.7	15.4	23.5	19.9	8.3	147.9	.....	.....	23.4	.....	.....	23.3	23.4
10–14	35.5	14.1	....	11.7	23.0	15.1	....	52.8	.....	36.9	.....	.....	11.2	10.2
15–19	55.4	102.4	69.6	60.5	43.4	106.8	.....	90.8	120.3	128.7	428.0	312.3	61.1	101.5
20–24	106.5	93.1	99.6	96.4	86.5	140.4	211.3	45.9	59.3	71.5	127.7	327.3	147.6	216.3
25–44	110.6	177.2	105.9	117.1	71.2	102.0	198.2	252.5	151.5	240.5	375.8	662.9	185.2	352.0
45–64	264.2	302.5	225.1	246.4	154.3	172.9	230.3	350.0	165.3	268.9	408.8	682.1	174.1	262.1
65–84	242.7	247.9	148.7	182.4	631.8	208.5	140.6	211.3	233.5	210.3	206.1	329.3	189.3	161.4
85 and over	.....	.....	....	.....	....	.....	180.2	210.7	.....	.....	....	357.6	60.0	69.3
Females:														
All ages	130.2	102.6	91.7	74.6	102.2	160.1	90.4	115.3	133.2	123.3	201.2	276.1	98.8	109.6
Under 10	27.4	.....	31.3	.....	42.0	34.0	.....	51.7	41.6	23.2	.....	.....	19.1	20.6
10–14	17.3	13.7	....	5.7	.....	89.1	.....	.....	.....	.....	.....	138.1	19.3	27.1
15–19	74.2	49.6	70.9	28.0	102.0	220.6	39.1	76.9	84.4	64.0	63.6	185.6	91.5	111.5
20–24	141.2	87.9	92.6	88.7	153.6	247.7	128.0	158.2	80.4	121.5	121.6	167.7	162.3	186.3
25–44	152.7	137.2	108.0	104.7	114.8	159.3	106.2	125.1	166.9	165.4	235.3	353.4	172.8	193.3
45–64	162.3	122.9	124.6	80.8	77.7	123.3	85.4	109.7	112.2	92.1	220.7	250.1	108.9	111.1
65–84	215.7	142.1	178.7	94.3	217.3	55.4	72.9	106.3	153.7	139.3	140.9	192.1	178.7	137.9
85 and over	.....	.....	....	.....	.....	793.7	156.7	80.3	314.5	164.5	148.6	.....	100.9	32.6

fact, at some of the age periods, the Irish males have as high tuberculosis death rates as have been found to occur among colored males. I would refer you to our fuller paper for the details, but here it is sufficient to observe that there is a real and marked difference between the various races much more in evidence among males than among females.

It is difficult for anyone confronted with these facts to escape the conclusion that an inherited racial immunity is a factor in the development of tuberculosis. Certainly, everyone must recognize that, with reference to such races as the Jews and the Italians, there is a constitutional resistance to tuberculosis and that among the Irish, there is a peculiar susceptibility to heavy mortality. The differences in economic status and modes of life are probably not sufficient to explain the extreme divergencies we have observed. This is clearly a count in favor of the second or genetic explanation for the development and decline of tuberculosis and those who favor this view have not been slow to emphasize this important fact in developing their argument. On the other hand, there are certain allied facts to be considered which throw additional light on this interesting phenomenon. The rates among the Jews and the Italians are not everywhere uniformly low, but show considerable variation from place to place, reflecting, in fact, the better and worse conditions among which the Jews and Italians of this country live. Thus Drolet, of the New York Tuberculosis Association, has shown that the Jews living in the various parts of New York City have markedly different tuberculosis death rates, varying from 83 per 100,000 in the old and congested downtown Gouverneur District to 52 per 100,000 in the newer and more open Bronx-Tremont District. Although the people are racially the same, the conditions of life are much more favorable in the newer sections of the city. Environment plays its part to color the racial picture. So, too, the high rates of the New York City Irish are markedly higher than the figures for these people in their native country, in fact often twice as high. Here, again we see the secondary effects of environment. The Irish immigrant is a crowded city dweller suffering from all the hardships of congested and impoverished city life. In the old country, they were, for the most part, rural dwellers. And, so, admitting the importance of the constitutional factor in the racial picture of tuberculosis, we must not lose sight of the equally great bearing of the environment within which the individual races live. While one race may enjoy an advantage over another with respect to tuberculosis, it is still capable of having higher and lower rates consistent with various modes and stations of life. In other words, in spite of the racial limitation, it is entirely possible for any people to modify a natural tendency to a high or a low rate through the development or neglect of safeguards which hygienic living apparently makes possible.

Variations in Economic Levels.—Another important fact in our discussion is the difference in the tuberculosis death rate in the various economic strata of the population. I have at my disposal a series of death rates for tuberculosis in three main groups of the population; first, for Industrial policyholders of the Metropolitan Life Insurance Company; second, for those who are insured in the so-called Intermediate Branch of this Company; and third, for those who are insured in the Ordinary Department. These three groups are sharply differentiated economically. The death rates are as follows: Let us take the age period 20 to 24 as an example. Among white males in the Industrial

TABLE 7

Mortality Rates from Tuberculosis—All Forms—Per 100,000 Exposed at Specified Age Periods. Males in Several Departments of Metropolitan Life Insurance Company and in U. S. Registration States, 1921.

Age Period	M. L. I. Co. males			U. S. Reg. States Total males
	Industrial* Department White lives	Intermediate† Branch Total males	Ordinary† Department Total males	
All ages—one and over	99.5	107.0	68.2	101.0‡
All ages—15 to 74	157.4	109.2	68.4	133.9
1 to 4	35.8	....	....	38.2
5 to 9	15.2	....	....	15.8
10 to 14	14.6	....	....	16.1
15 to 19	62.5	101.7	54.5	63.6
20 to 24	142.8	89.8	61.5	133.9
25 to 34	160.2	109.2	69.5	137.8
35 to 44	207.4	100.9	64.9	143.1
45 to 54	215.5	133.4	74.1	145.6
55 to 64	203.9	163.4	83.1	158.0
65 to 74	192.9	158.4	98.0	165.9

**Death* rates †*Claim* rates ‡Ages one to 74

Department the rate in 1921 was 142.8; in the Intermediate Department, 89.8, and in the Ordinary Department, 61.5 per 100,000. The other age periods show exactly similar relations. The highest rates are found uniformly in the industrial group. The intermediate rates are found in the Intermediate group and the lowest rates in the Ordinary group. The economic status influences, as we see, the incidence of tuberculosis. As you go from lower to higher levels of economic wellbeing, the rates go down uniformly. There is, however, this striking and instructive exception, namely, that economic status makes no difference in the ages

of childhood and adolescence. The children of the industrial population, i.e., of the working people, have lower rates for tuberculosis than exist in the general population. After age 20, the two sets of figures cross, and thereafter, the rates are lower for the general population than for the Industrial. The difference becomes greater with advancing age. (See Table 7, page 17).

How shall this set of facts be explained? The environmentalists rest their case on the hardships of the life of the poor as we have already intimated; the constitutionalists on the superior endowments and vigor of the selected or "fit" groups who make up the well-to-do and richer classes of the community as distinguished from the poor. But, how about the children? The figures would indicate, say the health workers, that the youngsters of the industrial classes are very well endowed, indeed, if their lower rates are an indication of their power of resistance. Is not this consistent also with everyday observation? Does not this fact indicate, they say, what one would suspect from other sources—that the working classes do not lack natural resistance? They do harder work, over longer hours and show in every way that innately their bodily vigor is no less developed than that of their better-off neighbors. But, constitutions are apparently not sufficiently ironclad to withstand without injury for long periods the wear and tear of modern industry. However good the initial endowment, long hours of toil in confined places often poorly ventilated, and only too often laden with dusts and poisons, the strain of attention to fast moving machinery, the effects of heat and the exhaustion of muscular energy, all finally tell. To these must probably be added the effects of frequent improper and inadequate diet, substandard housing, indifferent medical service and lack of opportunity for rest and recreation which are associated with the life of the poor. It is for this reason, as the environmentalists point out, that the industrial classes show higher rates and they do not begin to show them until the effects of their constant environment have begun to tell.

Occupation in Relation to Tuberculosis.—The incidence of tuberculosis in various occupations also throws light on the nature of the disease, on how it may be caused and how it may be controlled. I have already pointed out that those who are engaged in industrial processes show uniformly higher mortality rates than the general population of comparable age periods. This fact is strikingly brought out in the much lower death rates of females than of males during the working ages of life. But, even within the male sex, there is much variation among the several industries and occupations in which people are engaged. This fact has a long time engaged the attention of students of the disease, and an extensive and instructive literature has developed. The results of investigations have been so consistent and clear-cut that occupations have actually been graded in a series as to whether they are conducive

TABLE 8

Comparative Mortality from Phthisis among Males, Ages 25 to 65. Selected Occupations, Compared with Farmers. England and Wales, 1910, 1911, 1912 Combined.

OCCUPATION	Per cent. deathrate in specified occupation of phthisis deathrate among farmers
Farmers, graziers, farmers' sons, etc.	100.0
Railway engine drivers, stokers, cleaners	100.0
Motor car, motor van drivers	105.3
Builders	121.1
Agricultural laborers, farm servants	124.6
Brick, plain tile, terra-cotta makers	128.1
Iron-miners, quarriers	128.1
Engine-drivers, stokers, firemen (not Ry., Marine, agr., or elec. supply)	133.3
Coal miners	133.3
Shipbuilding	166.7
All shopkeepers	205.3
Cotton manufacture	210.5
Wool, worsted manufacture	217.5
Domestic coachmen, grooms	217.5
Bricklayers	224.6
Carpenters, joiners	224.6
Engine-, machine-, boiler-makers, fitters, millwrights	231.6
Copper workers, coppersmiths	256.1
Painters, decorators	268.4
Clerks	270.2
Brewers	317.5
Furriers, skinners	319.3
Hatters	321.1
Glass manufacture	322.8
Tailors	328.1
Watch, clockmakers, jewelers	328.1
Hotel keepers, publicans, spirit, wine, beer-dealers	347.4
Printers	368.4
Shoemakers	389.5
Brass, bronze workers, founders, finishers, workers	408.8
Stone-getters, dressers, masons	415.8
Seamen, etc. merchant service	456.1
Group of laborers	461.4
Potters-earthenware, etc. manufacture	494.7
Lead miners	587.7
Stone-getters, dressers, masons (counties producing sandstone)	728.1
Costermongers, hawkers	738.6
Barmen	761.4
File makers	761.4
Cutlers, scissors makers	817.5
Tin miners	1200.0

to the development of tuberculosis or not. On the whole, there is general agreement in the data for the several parts of the world.

Leaving out the professional group in order to avoid the complication of better economic status and other factors which might condition the result, and limiting ourselves to the fairly homogeneous group of wage earners and farmers, we find that the best conditions occur among those

engaged in agricultural pursuits. The tuberculosis death rate of this class of workers we may designate as our unit of measure. The other occupations may then be graded on the basis of the percentage which their tuberculosis death rate bears to that of agricultural workers. The table of occupations, (page 19), is selected from the report of the Registrar General for England and Wales for the years 1910, 1911 and 1912.

This table discloses a number of surprising relationships. Coal miners, who are engaged in fatiguing work and are exposed to dust, appear close to the best group. This phenomenon has, for many years, engaged the attention of tuberculosis investigators. The great mass of open-air workers on the railroads show extraordinarily favorable tuberculosis rates. In the complete list of the Registrar General, there are no less than 26 occupational classes which show a mortality from phthisis almost four times as great as farmers. Very high figures are shown for occupations exposed to hard metallic and mineral dust, such as, lead miners, with almost six times the farmer rate; file makers, with over seven times as much; and cutlers and scissors makers with over eight times. At the end of the scale are the tin miners with a rate twelve times the farmer rate. But such non-industrial occupations as barmen and seamen compete with the high figures already quoted.

The general conclusion drawn by most students of the relation of tuberculosis to industry has been that the highest rates are found among those exposed to mineral and metallic dusts; next to these are the occupations exposed to the use of alcohol, and then those who are exposed to lead. Certain occupations with exposure to the hardships of weather and occupations with exposure to organic dusts also, are generally found to have a high frequency. Investigation of the factors which enter into the lives of the various classes of industrial workers does not seem to indicate that high and low rates are always the direct influence of the occupation, but are often coupled with the mode of life and the home environment of the individual workers. Eliminating the very worst occupations, and limiting their observations to the great bulk of factory occupations which are neither dusty nor otherwise especially injurious, but nevertheless present high rates, Dr. Collis and Greenwood offer the following explanation: "The role of the factory is, by confinement in monotonously ventilated rooms and by causing general fatigue, to reduce the resistance of the operative to those sources of infection to which he is exposed in the natural course of life, to make him react more sharply to home influences than does his wife or sister."

For us, the important point is whether the evidence we have presented is more consistent with the one or the other of the two explanations as to the causation and the decline of tuberculosis which we are discussing. The theory of the geneticists would demand that those who are engaged in various occupations are selected somehow in accordance with their various grades of resistance and inherited ability to withstand tuberculosis. Some occupations undoubtedly attract weaker individuals. I doubt very much, however, whether such an explanation would apply to any considerable number of occupations we have listed. Obviously, many of the occupations with the highest rates call for workers with the greatest vigor. On the other hand, the effect of the industrial environment on the life of the worker is very clear-cut, even if often marked by the influences of economic condition, grade of intelligence, and other elements which affect life. The enormously high tuberculosis death rate of tin miners and of stone cutters is very clearly the result of the injury done to the lung tissue by the material with which they work. This is an extreme picture, but it points to the explanation which underlies the conditions in other occupations where the hazards are not so extreme or clear-cut, but, where just the same, the effect of the occupation makes itself felt. It makes little difference in the long run whether it be fatigue or monotonous employment, or the effect of vitiated atmosphere which breaks down the resistance of the individual and makes him an easier and earlier prey to the development of tuberculous disease.

Recent Changes in the Tuberculosis Death Rate.—Finally, we shall consider the changes in the tuberculosis death rate in recent years, both in this country and abroad, to see if in any way we may be able to throw light on the nature of the disease and to determine whether the facts are more or less consistent with one or the other of the two theories which attempt to explain its causation and the method of its control. As we have seen, the tuberculosis death rate in the general population of the United States has fallen 50 per cent. in a twenty year period. In the special but large group of insured lives, the same amount of reduction has been observed in a ten or eleven year period. In more recent years, since 1918, declines of as much as 10 or more per cent. per year have occurred. The decline, moreover, has not been uniform in all the groups of the population, but has favored males more than females, white lives more than colored lives, and certain definite age periods more particularly than others. We find, for example among the insured lives where this phenomenon has been carefully studied, that white males showed a decline of 55.0 per cent. in the ten year period between 1911-1912 and 1921-1922, as contrasted with a decline of only 41.5 per cent., in the same period for white females. Table 9, page 22 presents the details, which are also shown in graphic form in Chart 4, page 23.

The chart on page 23 shows the above changes in sharp relief. With this evidence in mind, one would be tempted to deny that the type of age incidence in tuberculosis has any marked stability. Certainly there can be no ground for the conjecture of Dr. Brownlee that the contour of the curve for age indicates the existence of three distinct types of tuberculosis, namely, a type chiefly affecting youth, a second affecting persons in middle life and third, a type attacking persons in old age. The facts for the four classes of Industrial policyholders, as shown in Chart

4 and which are perhaps accentuated examples of what has occurred in the general population, leave us convinced that tuberculosis is not a slowly changing condition with fairly fixed characteristic of sex, color and age incidence, but a more fluid phenomenon responding quickly and incisively to external modifications when these are properly chosen and well directed.

Of greatest interest is the fact that the maximum decline occurred among white males in the period between 20 and 45 years of age, where the decline approximated 50 per cent. The greatest decline has occurred where the rates were originally highest and least where the rates were lowest. There is a close association between the amount of decline and

TABLE 9

Percentage decline in Deathrate from Tuberculosis—all forms. 1921–1922 since 1911–1912.

By Color, Sex and by Age Periods

Metropolitan Life Insurance Co. Industrial Department

Age periods	Total Ind'l Dep't	White		Colored	
		Males	Females	Males	Females
All ages—1 & over	47.0	55.0	41.5	43.1	33.1
1 to 4	56.4	55.2	56.4	55.7	49.4
5 to 9	56.1	45.1	58.7	47.7	55.8
10 to 14	36.5	39.0	31.1	33.5	34.9
15 to 19	31.8	43.4	21.2	32.1	28.6
20 to 24	35.1	47.9	28.5	38.9	17.8
25 to 34	51.4	61.2	46.4	47.1	29.4
35 to 44	57.2	63.9	53.0	50.2	43.2
45 to 54	47.2	50.6	42.5	45.3	35.4
55 to 64	43.7	44.3	41.4	42.4	36.6
65 to 74	29.2	25.9	33.5	29.0	9.1
75 & over	38.2	29.3	42.4	3.3*	58.9

* Denotes increase.

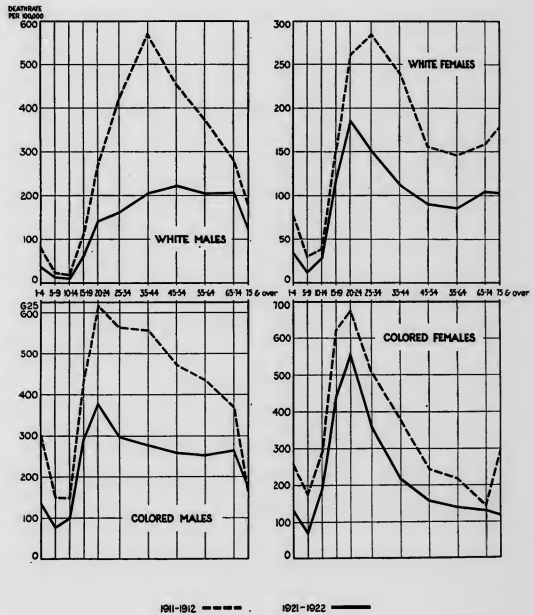
the excess of the death rate in the earlier periods. Of equal importance is the fact that, in the general population, especially in the large cities, the most marked reduction in the tuberculosis death rate has occurred in the period of early infancy. In the City of New York, the decline in the tuberculosis rate in ten years in the period under age one was 53 per cent., as compared with a decline of 40 per cent. at all ages.

On the other hand, the same years which experienced the remarkable decline in the death rate in the United States saw on the Continent of Europe an equally decisive rise in the death rate. Incidental to the war and to the miseries which resulted from it, the death rate from tuberculosis in virtually all the countries of Europe rose to heights equalled only in the years before the tuberculosis campaigns. All the gains of

CHART 4

Death Rate *per* 100,000 *from* Tuberculosis-All Forms
Periods 1911-1912 compared with 1921-1922 *by* Color, Sex *and by* Age Periods.

METROPOLITAN LIFE INSURANCE COMPANY.
INDUSTRIAL DEPARTMENT.


DEATHRATE PER 100,000
WHITE MALES
WHITE FEMALES
COLORED MALES
COLORED FEMALES
1 4 5 9 10 14 15 19 20 24 25 34 35 44 45 54 55 64 65 74 75 & over
1911-1912
1921-1922

twenty-five or thirty years were apparently lost in the three or four years of war and in the periods of stringency immediately thereafter. In the German cities with populations of 15,000 and over, the death rate, which in 1913 was 157 per 100,000, rose in 1918 to a maximum of 287. Individual cities like Vienna and Warsaw showed much worse conditions. In 1913, the rates for tuberculosis in these two cities were 302 and 306 per 100,000 respectively. By 1917, at the height of the war, these figures had risen to 425 for Vienna and 840 for Warsaw, declining in 1920 to 405 and 338 per 100,000 of population. Cities which, like Belgrade, passed through long periods of military occupation and food stringency showed maximum rates, rising even to the horrifying figure of over 1,400 per 100,000 during 1918. But the high rates did not continue following the resumption of industry and the return of fairly normal conditions. The most recent figures show that the death rates from tuberculosis are back approximately where they were at the beginning of the war and, in some countries, they have fallen to figures well below those recorded prior to 1914. The picture with regard to tuberculosis in the European countries is, however, too well known to require any marked elaboration in this address. How shall we interpret these interesting facts both in the United States and abroad? They are no mere chance occurrences, covering as they do so large a group of people and being so different on both sides of the ocean. The figures are just as instructive as to the nature of the disease as are any of the demographic items to which we have already directed attention. How do they square with the two explanations we have considered? Can the rapid decline in the rate in the United States and the equally rapid increase in Europe be made consistent with the assumption that the constitutional factor is the only vital one in the tuberculosis situation? As we have seen, the very nature of the tuberculosis picture was markedly changed; in the one case for the better, in the other, for the worse. In America, the incidence of the disease by age was so completely changed during ten years that one would hardly recognize the curve for age in 1922 as representing the same disease in 1911. Changes in germ-plasm are fixed by inheritance and cannot be developed in three or four, or even ten years. They take generations for their fulfillment, and cannot, therefore, be the cause for what occurred in the last few years.

Certainly as applied to the United States, there is no evidence that the changes that have occurred in the last decades have come about through any improvement in the racial constitution of the people. The eugenists have not lost an opportunity to say that in their opinion no improvement has occurred and, if anything, there has been deterioration. They have pointed to the decline in the birth rate of the most favored classes, to the extensive immigration into the country of large numbers of less favored people and to the other items that show that the inherent capacity of the population may not have improved. It would seem, therefore, that if the tuberculosis death rate has declined

in the United States, it has not done so because of the improvement of stock during the period under question, but rather in spite of it.

On the other hand, the facts in both parts of the world are not at all inconsistent with the assumption that we are concerned with changes in the environment of the individuals whom we are considering. In America, we see clearly evidences of remarkable improvement in the status of the great mass of the people; the bettering of the conditions under which they must work; the shortening of their hours of labor and the increase of their earnings. From every angle, there is good evidence that the population of America is better off. Never before in the history of the country has so favorable a change come over the environment of the people as in the years subsequent to the great war. Those who are engaged in the anti-tuberculosis programme point to the enormous increase in the effectiveness of their organization, in the multiplication of their facilities for the care of the tuberculous, to the widespread campaign of education which has taken hold of the imagination of the people, affecting not only the school children but the whole of the population.

The losses sustained in the tuberculosis movement abroad are just as clearly related to the marked retrogression in the well-being of the people. There were no fundamental changes in the germ-plasm of the civilian population of Europe, but rather in the number and character of the hardships to which they were exposed. The lack of food, of clothing and of housing; the many worries and the disregard of hygiene, which could scarcely be avoided, went hand in hand with the mounting death rates from tuberculosis. The changes which occurred in Europe on so large a scale and which were so sharply defined show that there can be no mistake as to the relationship of environment to tuberculosis. The facts, such as they are, are as conclusive as the facts of any laboratory experiment. It is on such grounds that those who consider the environmental factor as dominant, rest their case.

May we not, therefore, conclude from this first section of our discussion that the very nature of the disease as expressed in its differential incidence in the various groups of the population and in its capacity to change is more consistent with the first rather than with the second of the two explanations? It seems to me very clear that taking all of the facts together, we are led into fewer difficulties by this course. The second explanation, which assumes a differential racial constitution and inheritance corresponding to the differences in the death rates, requires in its turn still further explanation. The evidence is good that the factor of immunity and racial constitution must be considered. But, there has not been sufficient change in this regard to account for the reduction in the death rate. Possibly, further research will add to the importance of this factor by identifying certain types of constitution which go with the greater or lesser ability to resist the development of tuberculosis.

But, this must always remain a minor item in the tuberculosis campaign as it is organized in the United States and in other civilized countries. In the last analysis, it is the kind of environment we live in that determines the high or low rate which prevails.

III. DIRECT RESULTS OF THE WORK BY THE TUBERCULOSIS AGENCIES

Fortunately, there is at our disposal another and a more direct mode of approach which shows very clearly how effective are environmental influences in the control of tuberculosis. We shall from this point on, concern ourselves with an attempt to evaluate some of the major activities which have been developed in conjunction with the tuberculosis programme to see if we can measure how much of the actual decline in the death rate can be directly traced to them.

One of the first steps in the tuberculosis campaign has been to discover the early cases of tuberculosis and to provide care for them. For thirty years, the sanatorium movement has developed rapidly and, today, in the United States, there are available close to seventy thousand beds for the care of the tuberculous. The theory behind this development has been that those who receive such care have their disease more or less arrested and their lives lengthened. We have been very negligent in not attempting heretofore to evaluate this phase of the tuberculosis movement, for much of the necessary evidence is at hand.

The end results of sanatorium care, quite irrespective of the location of the institutions, are strikingly similar. Incipient cases give the best promise, although the sanatoria cannot quite wipe out the effects of the disease in even such cases. But, the records of the sanatoria of the country show clearly that the after-mortality among the graduates is from two to three times the normal for age. Those who have been admitted in a moderately advanced stage of the disease have a subsequent mortality from eight to ten times the normal for age, and those who have been admitted as "far advanced" cases show a mortality from thirty to forty times the normal for age. These results are not limited to one sanatorium alone but are typical of sanatoria in general. Patients treated at Trudeau, at Mt. McGregor, in the King Edward VII Sanatorium, do a little better than we have assumed. We have minimized the gains to make them more representative of average sanatorium conditions.

In contrast, the tuberculous, as a whole, have a mortality approximately 14 to 15 times the normal for age. This is indicated by the fact that the fatality rate among the tuberculous is approximately ten per cent., or 100 per 1,000 per year, whereas, the mortality rate of the general population at corresponding ages is approximately seven per 1,000. An estimate

of fifteen times the normal mortality for the tuberculous in all stages is reasonable. It follows, therefore, that the effect of sanatorium care consists in converting groups of individuals who, if left to their own devices, might be expected to die at a rate of fifteen times the normal into groups who die at a rate of from two to three times the normal as do the incipient or from eight to ten times the normal as do the moderately advanced cases. The far advanced cases probably receive benefits as well, but their mortality rate is well above the average of the tuberculous, and there is no satisfactory evidence as to the saving actually effected. But, even as to them, there are other community advantages which justify their care in sanatoria.

Let us see then what the effect of sanatorium care is on masses of tuberculous cases. The best estimates that I can find indicate that about 40 per cent. of the beds are available to early and incipient cases, about as many more to the moderately advanced cases, and the remainder, or 20 per cent., to far advanced cases. In a typical thousand cases in sanatoria, there would then be 400 incipients, 400 moderately advanced and 200 far advanced. As the result of the sanatorium care on the above basis, there should be annually, subsequent to discharge, a total of about 90 deaths per thousand. In the community at large, the number of deaths in a typical thousand of the tuberculous population would be 100. There is, therefore, a net saving of 10 deaths per thousand per year on the most conservative basis that we can use. This is equivalent to a saving of ten deaths out of every 100 that would otherwise occur, or 10 per cent. in the total tuberculosis mortality. The importance of this saving depends, of course, on the total numbers of persons who receive sanatorium care. At the present time, there are approximately 70,000 beds caring for well in excess of 110,000 patients each year. There is, therefore, a saving of at least eleven hundred lives a year as the result of the return to the community of the patients of the preceding year. The number is not quite so large for past years since the movement for providing sanatorium beds has been a rapidly growing one. In 1904, there were 10,000 such beds; in 1910, these had increased to 26,000 and, in 1922, as we have said, the number was about 70,000. These beds have an average turnover every six months, but are not always fully occupied throughout the year. The maximum capacity may need to be discounted by perhaps as much as 20 per cent. On this basis, I estimate that not less than 800,000 persons have passed through these sanatoria during the last decade, of whom close to six hundred thousand are still alive and showing the benefits of reduced mortality in their respective communities. At a minimum, therefore, there are 6,000 less deaths per year from tuberculosis in this group than would have occurred if sanatorium beds had not been available. There is also a considerable number, not easily estimated, who received sanatorium care in prior years, and who are still alive. The saving which has occurred among them will increase the total to well in excess of the

6,000 lives annually which we have ascribed to the effects of sanatorium care. In fairness, however, such gains as we have noted should be credited to the whole tuberculosis programme of which the sanatoria are only a part. Without the clinics and their expert medical and nursing facilities, the auxiliaries and the social workers, many of the patients would never have been discovered in the early stages of the disease nor admitted to sanatoria, nor kept there until the treatment was completed.

There are, in addition, a large number of patients who receive excellent care at the hands of private physicians, a large number of whom are expert in the treatment of the tuberculous. At Saranac Lake and other centers of the country, large colonies of the tuberculous have gathered where they enjoy much the same type of supervision, direction and care as do those in the best sanatoria. It is, unfortunately, impossible to estimate their number. But that it is large and that the results obtained are in many ways comparable with those of the best sanatoria, there is little question. It is regrettable that no estimates can be made of the saving in lives accomplished through this medium. The number must be large, however, and would add materially to the number already credited to the effects of sanatorium care.

It is not my purpose in this address, even if it were possible, to exhaust all the major activities of the tuberculosis movement and to evaluate the life saving achievement of each one of them. My purpose has been rather to show how a typical and important agency has actually resulted in a measurable amount of life conservation. That should serve as an indication of what may be accomplished by the others, although it will always be impossible, I suppose, to determine how much good results from such work. Important as was the first or logical side of our argument, this brief contribution on the direct results is even more important. Together, the evidence should be irresistible that the recent decline in the tuberculosis rate can be largely credited to the agencies which have been put into operation, directly or otherwise, to control tuberculosis.

You will notice that I am careful not to ascribe the entire gain to the tuberculosis movement. It is entirely conceivable that more has been accomplished through the increase in real wages of the working classes of the country, through the improved working condition in the factories, and the improved wellbeing of the great mass of the workers, than from all of the direct activities of the movement itself, such as, sanatorium care, the service of physicians, etc. But, it is to the great credit of the tuberculosis campaign that so much of the enlightenment that now prevails in the relationship between employers and employees has resulted from the intelligent stimulation by health and social workers who have been interested in the control of tuberculosis. The campaign of education has not been waged for naught. Any one who is familiar with what has been accomplished in this country in the field of health

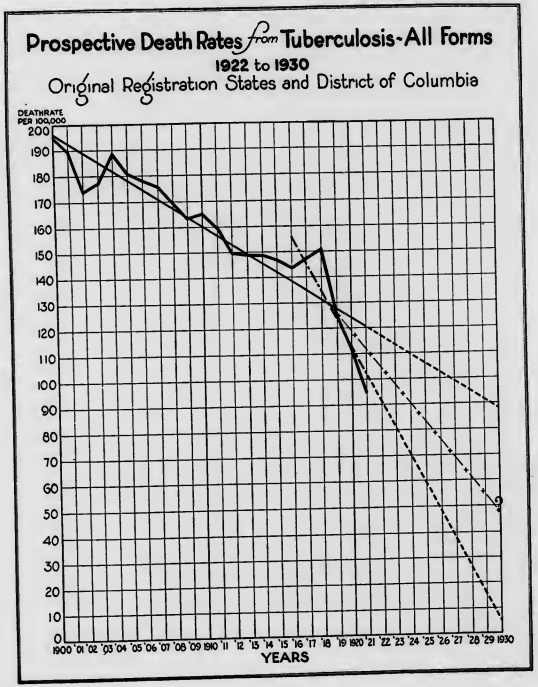
education cannot fail to be impressed with the value of the work. The tuberculosis movement, be it either through its direct or its indirect influences, has made the body of American men, women and children more resistant to the development of infection, keener to know the state of their health, more intelligent as to their needs when disease has developed, and more likely to obtain proper and sufficient care. The tuberculosis movement, therefore, stands clearly and outstandingly as a major force in what has been accomplished.

IV. THE OUTLOOK FOR THE FUTURE

No one can possibly be familiar with the history of public health in the last twenty years and be other than optimistic as to the future of the tuberculosis campaign. The experience through which we have passed has clearly demonstrated that the campaign has been well conceived and that the individual activities have been, on the whole, well conducted. The effort has justified itself and is worthy of further extension. Much is still to be desired in making approved facilities available to the great mass of the American population and, even when available, so to coordinate them that the most effective results will be obtained. You will remember that with reference to the effectiveness of sanatoria, everything depended upon their ability to serve the incipient cases first. It was because they succeeded in obtaining 40 per cent. of their cases in the incipient stage and the rest moderately advanced and far advanced, that a saving in mortality of 10 per cent., could be accomplished. If the sanatoria in the future could succeed, through the coöperation of the diagnostic and the social service agencies, to bring incipient cases instead of advanced and far advanced cases to their service, the mortality saving would be materially increased. Even if sanatorium care itself were not made more effective, a change of the present proportions to 60 per cent. incipient, and 20 per cent. moderately advanced, and 20 per cent. far advanced, would increase the annual mortality saving from 10 per cent. to 22 per cent. per year. Coupled with this internal change in the management of sanatoria, there must be a further development of sanatorium and bed facilities over many large areas of the country. There are still too many states with either no or an inadequate number of sanatorium beds available to the tuberculous. We may look forward, I believe, to a rapid extension of such facilities in the near future.

What then, may we say, on the basis of the facts of the last twenty years, is the probable future trend of the tuberculosis death rate, and what may we expect to achieve by the year 1930? While our data are in many ways reliable, there is, nevertheless, an element of uncertainty in making forecasts of this kind. As you will remember, the changes in the tuberculosis death rate in the last few years have been very marked indeed and rather unexpected. If, to be conservative, we

CHART 5



assume that the trend line of the last twenty years will continue without change up to and including 1930, we may expect on that basis a death rate of 88 per 100,000 at the end of this decade. But, this rate is obviously too high as indicated by the fact that the population had a rate in 1922 already probably below 90 and that in 1923 the figure will be still lower. If, on the other hand, we were inclined to be more radical and were guided by the trend of the last five years, say from 1916 to 1921, the estimated rate in 1930 would be about 7 per 100,000. We know very well, however, that marked declines such as have occurred in the years 1919, 1920, and 1921 are not likely to continue in equal measure for a long period. In fact, the years 1922 and the current year have shown a tendency to ease off in the rate of decline. My best judgment, is, therefore, without making an attempt at finality or to involve myself in any hairsplitting mathematical speculation, to compromise on the two estimates, that is, to assume a figure midway between 7 and 88. That gives a rate which, I believe, is much more probable than either, namely, about 50 per 100,000 for the year 1930. That is, in fact, the result which would follow if the tendencies of the last few years were slowed up about one-half for the remainder of the decade. Chart 5, page 30, gives us an interesting picture of the two trends based upon the long and the more recent period of years, and of the development of the probable rate for 1930.

A tuberculosis rate of 50 per 100,000 will, I believe, be found to be not far from the actual figure in 1930. Please remember that in New Zealand and in Australia, a death rate from tuberculosis of 50 has already been attained. Three states of the United States in 1921 had rates below 50; in fact, two were below 40. It is for this reason that I am encouraged to consider this estimate entirely reasonable. It may even be lower provided an effort is made during the next years to apply the lessons of our experience with this disease during the last twenty or thirty years. It may be much lower also if some effective biological or other new method is discovered for the treatment or prevention of tuberculosis. The tuberculosis movement must not rest on its laurels nor be allowed to drift along easy ways. The disease is on the decline. This is an opportune time to apply even greater energy along approved lines, that there may be no diminishing but rather cumulative returns in life saving.

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